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CASSETTE FOR STORAGE PHOSPHOR MEDIUM

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CROSS REFERENCE TO RELATED APPLICATIONS

This is a 111A application of Provisional Application U.S. Serial No. 60/444,462, filed February 3, 2003.

FIELD OF THE INVENTION

The invention relates generally to cassettes, and in particular to a cassette for an x-ray phosphor film plate of the kind used in computed radiography.

BACKGROUND OF THE INVENTION

In computed radiography, a photographic element (also often referred to as a medium) has an image formed thereon by x-rays, and the element is subsequently provided to a processor/reader where the photographic element is stimulated to emit a radiation pattern that is captured for storage and use. Cassettes of the kind used in computed radiography (CR) may comprise a container having upper and lower parts that are hinged together so that they can be opened for insertion of a thin, flexible film sheet or rigid film plate comprising the photographic element. The cassette is closed and latched so that the cassette with the element therein can be used with an x-ray apparatus to produce an image on the photographic element. Then the cassette is taken to a reader where the cassette must be opened and the photographic element extracted by suitable feeders, such as suction feeding devices. The photographic element is separated from the cassette and transported through the reader where it is stimulated to emit a radiation pattern and subsequently erased before being returned to the cassette for re-use.

The following patents disclose various types of storage phosphor cassettes: U.S. Patent No. 5,379,997, issued Jan. 10, 1995, inventor Ohta and U.S. Patent No. 5,265,865, issued Nov. 30, 1995, inventors Agano et al.

The cassettes and the photographic elements as described above have generally been satisfactory, however, there exists a need for a cassette which supports a thin, flexible sheet that can be readily extracted from the cassette by a

reader having a minimal footprint or extraction area to access the storage phosphor sheet.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a stimulable storage phosphor sheet cassette.

Another object of the present invention is to provide such a cassette suitable for use with a stimulable phosphor sheet processor (i.e., a reader).

A further object of the present invention is to provide such a cassette wherein a stimulable storage phosphor sheet can be extracted and inserted into the cassette.

These objects are given only by way of illustrative example, and such objects may be exemplary of one or more embodiments of the invention. Other desirable objectives and advantages inherently achieved by the disclosed invention may occur or become apparent to those skilled in the art. The invention is defined by the appended claims.

According to one aspect of the invention, there is provided a cassette, comprising a box member, an access member, and a transport member. The box member is adapted to house a sheet-shaped image medium therein. The box member is provided with an opening through which the medium can be fed into and out of the box member along a first direction. The access member is attached to the box member and movable about an axis substantially perpendicular to the first direction between a first position wherein the access member is disposed in the opening and a second position wherein the access member is not disposed in the opening. The transport member is disposed within the box member and translatable within the box member in the first direction to move the medium into and out of the box member through the opening when the access member is in the second position.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other objects, features, and advantages of the invention will be apparent from the following more particular description of the

preferred embodiments of the invention, as illustrated in the accompanying drawings.

FIG. 1 shows a perspective view of a cassette in accordance with the present invention.

FIG. 2 shows a perspective view of a non-imaging panel of the cassette of FIG. 1.

FIG. 3 shows another perspective view of the cassette of FIG. 1.

FIG. 4 shows a perspective view of the drive piston and associated mechanisms disposed within a channel in one frame of the cassette.

FIG. 5 shows a perspective view of a portion of the frame of the cassette.

FIG. 6 shows another perspective view of the drive piston and associated mechanisms of FIG 4 including the access member in a closed position.

FIG. 7 shows a cross-sectional side view of the cassette of FIG. 1 showing the access member in an open position and the medium/screen disposed within the cassette.

FIG. 8 shows a perspective view of the cassette of FIG. 1 with the top panel (imaging panel or tube side panel) removed to show a perspective view of the access member, screen transport, and support plate.

FIG. 9a shows an exploded perspective view of the screen transport and support plate.

FIG. 9b shows a side view of the screen transport and support plate.

FIG. 10 shows a cross-sectional side view of the cassette of FIG. 1 showing the access member in a closed position and the medium/screen disposed within the cassette.

FIG. 11a shows a perspective view of the screen assist mechanism when the medium/screen is disposed within the cassette.

FIG. 11b shows a perspective view of the screen assist mechanism is FIG. 11a when the medium/screen is partially disposed within the cassette.

DETAILED DESCRIPTION OF THE INVENTION

The following is a detailed description of the preferred embodiments of the invention, reference being made to the drawings in which the same reference numerals identify the same elements of structure in each of the several figures.

A storage phosphor cassette 100 in accordance with the present invention is now described with reference to Figures 1-11.

Generally, cassette 100 is comprised of a box member adapted to house a sheet-shaped image medium therein, an access member, and a transport member. The box member is provided with an opening through which the medium can be fed into and out of the box member along a first direction. The access member is attached to the box member and movable about an axis substantially perpendicular to the first direction between a first position wherein the access member is disposed in the opening and a second position wherein the access member is not disposed in the opening. The transport member is disposed within the box member and translatable within the box member in the first direction to move the medium into and out of the box member through the opening when the access member is in the second position.

More particularly, cassette 100 comprises a box type housing used for storing, image collecting and transporting storage medium to and from a processor/reader which is well known in the art. The medium can also be referred to as a screen, and an example of such medium is a storage phosphor screen, and such a screen can be flexible. Cassette 100 is configured to enable a reader to have a small extraction area/opening to access a flexible sheet disposed within cassette 100.

Cassette 100 is shown as a six-sided box wherein one side 2 includes a movable member. More particularly, three sides of the box form a rigid frame (Figure 1, elements 1a, 1b, 1c) with a fourth side (element 2) being open so as to support/form a member (further described below) which moves to allow movement of the flexible storage medium into and out of cassette 100.

Cassette 100 further comprises upper and lower rigid panels 10, 12 (best shown in Figure 7 as flat panels) which are supported by the three sides . An

image capture side 10 (commonly referred to as the Tube Side) of cassette 100 includes a low radiographic absorption material. Panels 10,12 are preferably comprised of a composite laminate material having two thin outer layers of aluminum with a polypropylene core disposed therebetween so as to result in a lightweight cassette. Panels 10,12 can also be fabricated from materials such as carbon fiber or a polymer, or aluminum. Panels 10,12 preferably have a full polymer sheet of graphics applied to the outside face (for example, prior to final panel fabrication) with such a sheet allowing for an easily modifiable cassette graphics design.

The bottom panel 12 (i.e., the non-imaging side) preferably includes a recess 14 for increased rigidity as well as a weight saving elevation change on the internal area of the cassette. Bottom panel 12 of cassette 100 can be bonded with adhesive and/or fastened with fasteners to the frame (i.e., sides 1a, 1b, 1c) of cassette 100. Top panel 10 can be configured so as to be removable to allow assembly and service to cassette 100.

Four corners elements 4a, 4b, 4c, 4d of cassette 100 are preferably comprised of an opaque polymer material which provides light blockage and absorbs impact energy in the event of an accidental drop or abuse of cassette 100 during usage. Two of the corner elements (4a, 4b) incorporate features to position and move a movable member 16 (best shown in Figures 7 and 10) incorporated in side 2 for the flexible storage medium insertion and extraction. As such, movable member 16 acts as a door, cover, or shutter to allow insertion and extraction of the medium into/from cassette 100. Figure 7 shows movable member 16 disposed in an open position for insertion/extraction of the medium, while Figure 10 shows movable member 16 disposed in a closed position.

Movable member 16 of the cassette 100 can be actuated by means of an access member 18, shown in Figure 3 as an opening/slot. As shown, access member 18 is formed in a drive piston 20 which slides relative to one of the sides, shown in the figures as side 1c, wherein in a preferred arrangement, drive piston 20 is disposed within/inside side 1c.

The reader can include a rigid feature such as a pin. In the present invention, a single such rigid feature can be employed to unlatch cassette 100,

open the door (access member 16) to the cassette, and actuate a translation member as further described below. More particularly, the rigid feature of the reader (not shown), such as a pin, is inserted into access member 18 to release a spring loaded hook/pawl 22 (best shown in Fig. 4) attached to drive piston 20. The drive piston 20 and pawl 22 are preferably located within a hollow channel of side 1c. Within drive piston 20, spring loaded pawl 22 pivots on a pin, causing it to disengage a catch pin 24 in side 1c of the cassette (refer to Figure 5).

One end of a compression spring 26 (refer to Figure 4) contacts an anchor block 28 secured to side 1c, and the other end of compression spring 26 contacts a floating spring stop 30. Once drive piston 20 is disengaged, compression spring 26 contacts a floating spring stop 30 (refer to Figure 4), thereby allowing compression spring 26 to expand. This spring expansion of compression spring 26 displaces floating spring stop 30, which has a fixed interface with a rigid door-opening component 32 (shown in Figure 4 as a push rod) which can be constructed from a formed spring wire and attached directly to an off-center position in movable member 16. A translation of push rod 32 generates a force and displacement of push rod 32 such that the off-center connection to movable member 16 causes movable member 16 to rotate/pivot open whereby the flexible storage medium can be inserted or removed from cassette 100. Figure 7 shows movable member 16 in an open position while Figure 10 shows movable member 16 in a closed position wherein cassette 100 forms a substantially light-tight enclosure suitable for use with storage phosphor screens.

The rigid pin (formed in the reader, not shown) that can be employed to release pawl 22 also provides for translation of drive piston 20. That is, the pin (of the reader, not shown) provides a force that moves drive piston 20.

Drive piston 20 is directly connected to a screen transport 34 (e.g., a carrier; translation member; transport member), generally shown in Figure 8. Screen transport 34 provides a means to assist in the transport of the flexible storage medium (i.e., a screen) into and out of cassette 100. In the present invention, screen transport 34 contacts the screen to move/carry the screen into and out of the cassette. As such screen transport 34 acts as a carrier for the screen.

For example, screen transport 34 delivers a portion of the screen to the reader wherein rollers or other means (not shown, a component of the reader) continue the extraction of the entire screen from cassette 100.

As best shown in Figures 9a and 9b, in the present invention screen transport 34 is comprised of a support plate 36 preferably constructed from a non x-ray reflecting material so as to minimize backscatter, for example a polymer. Support plate 36 connects directly to drive piston 20, for example by means of tabs/connectors 38a, 38b, 38c for carrier motion control. Tabs 38a, 38b, 38c can be reinforced with a high strength, interlocking component for added durability 40a, 40b, 40c. A bottom portion of screen transport 34 preferably includes a low friction tape 42 to promote sliding and antistatic characteristics.

A surface of screen transport 34 (labeled as element 34 in Figures 9a and 9b) is preferably comprises a material that controls the frictional interaction of the screen to allow the screen to stick/adhere/contact to screen transport 34 for insertion and extraction with the reader yet also allow slippage when the reader inserts and extracts the screen from cassette 100. A suitable material for screen transport surface 34 is a substantially pure neoprene foam.

As best shown in Figure 7, at the limit of the screen transport's 34 translation within cassette 100 during the screen's extraction from cassette 100, support plate 36 interlocks/abuts with a medium spacer-guide 44, pulling screen transport 34 downward, to promote a smooth transition for the screen onto screen transport 34 when the screen is inserted into cassette 100. Spacer-guide 44 can be comprised of a non x-ray reflecting material, for example a polymer. Spacer-guide 44 can also be comprised of a material having low triboelectrification properties or Inherently Dissipative Properties (IDP) to assist in the control of electrostatic charging. Preferably, screen transport 34 remains at its translation limit position until the reader returns the screen to cassette 100 when image collection is complete.

To provide positional control of screen transport 34 (i.e., rotational and translational control) and flexible storage medium (i.e., the screen) during actuation, at least one sliding idle piston 46 (shown in Figure 9a) or roller pistons

48 (shown in Figure 9a) can be attached to support tabs 38a, 38b, 38c so as slide inside a hollow frame channel.

To assist screen transport 34 in extracting the flexible storage medium from cassette 100, a screen assist mechanism 50 (best shown in Figures 11a and b) can be provided at the start/actuation/beginning of the extraction process. As shown in Figures 11a and 11b, screen assist member 50 is configured as a flexible spring (i.e., leaf spring) member under compression and is attached (preferably with pins or fasteners) to side 1b. When access member 16 is closed and drive piston 20 is locked, screen transport 34 positions/locates screen assist mechanism 50 such that no loaded contact is made with the screen. When drive piston 20 is engaged and driven towards the cassette opening (i.e., access member 16 is in the open position in side 2 so as to allow insertion/extraction of the screen), screen assist mechanism 50 engages the screen, thereby applying a force to the screen greater than the frictional interaction force of the screen and the screen transport surface 34. The assist continues until a position just beyond where the reader (not shown) begins to extract the screen from cassette 100 (best shown in Figure 11b). Screen assist mechanism 50 is employed such that should the screen stub (i.e., resist extraction) upon extraction from cassette 100, that any slippage with respect to the screen transport that occurs would not affect the screen's ability to reach the reader rollers.

Access member 16 of cassette 100 allows for the screen extraction and insertion to take place with cassette 100, and in addition, when access member 16 is open, access member 16 operates as a guide for the screen movement into and out of cassette 100. When access member 16 is in closed position relative to cassette 100, access member 16 operates to shield/block light from reaching the flexible storage medium by sealing off the opening (i.e., side 2) (as best shown in Figure 10). In this position, access member 16 also operates as a stiffener providing rigidity to the open box structure/frame of cassette 100. In a preferred arrangement, access member 16 pivots to move between its open and closed positions. In this arrangement, access member 16 includes a pivot center that can be controlled by a pair of pins 52 (one of which is shown in Figure 6)

positioned on opposite ends of access member 16 and interface with the front corner elements.

Along the top and bottom edge of the cassette opening (side 2) surrounding access member 15 are two guides/stiffeners 54,56 (best shown in Figure 10). Top guide/stiffener 54 can be adhered/bonded to panel 10 (i.e., the tube side panel) so as to provide medium guidance and a light seal seat for access member 16. Lower stiffener/guide 56 can be adhered or mechanically fastened to bottom panel 12 to provide medium guidance and to be removable for service.

Once the reader has finished collecting the image data from the screen, the screen is returned to cassette 100 by a distance determined by the last pair of rollers (of the reader) closest to cassette 100. An example of a possible distance is about 0.25 inch (6.4mm) to about 1 inch (25.4 mm). This distance varies from the translation distance of screen transport 34 during both insertion and extraction wherein the distance traversed by screen transport 34 can range from about 2 inches (50.8 mm) to about 5 inches (127 mm) for the embodiment described herein in accordance with the present invention.

When the screen is returned to (inserted into) cassette 100, drive piston 20 is moved in a direction away from access member 16 thus moving screen transport 34 and retracting the remaining length of the screen into cassette 100. Near the end of travel of screen transport 34, screen assist mechanism 50 re-engages screen transport 34 preparing it for the next screen extraction from cassette 100. Drive piston 20 then begins to engage an over travel compression spring 58 (best shown in Figure 4). When drive piston 20 is in a locked state, over travel compression spring 58 applies a load to spring stop 30 that is greater than the spring force of door opening compression spring 26 thus providing tension to push rod 32. This tension provides a spring-loaded closure of access member 16 against the upper guide/stiffener 54 and promotes the biasing of access member 16 in a closed position without regard for a tolerance stack up. In the over travel position of drive piston 20, spring loaded release pawl 22 is positioned such that it is beyond the latch catch pin 24 at which point the actuation pin (on the reader) is removed from drive piston 20. The springs of pawl 22 repositions pawl 22 to

locate on the latch catch pin 24 whereby cassette 100 can be remove from the reader.

Cassette 100 can include one or more pockets 60 (best shown in Figure 2) in the sides of cassette 100 that allow the reader to clamp cassette 100 into the reader.

Shown in Figure 7, disposed inside of cassette 100, on the tube side panel (panel 10), a low x-ray absorption material 62 can be applied to the surface to reduce or eliminate abrasion damage of the screen and to minimize triboelectric charging of the screen and cassette.

In addition, a lead foil can optionally be applied on the inside of cassette 100, to bottom panel 12, to absorb any x-rays that pass through the screen. Still further, material is applied to the surface of the lead foil on the bottom panel to reduce the triboelectrification of the carrier transport and reduce frictional loading due to this sliding motion.

The invention has been described in detail with particular reference to a presently preferred embodiment, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention. The presently disclosed embodiments are therefore considered in all respects to be illustrative and not restrictive. The scope of the invention is indicated by the appended claims, and all changes that come within the meaning and range of equivalents thereof are intended to be embraced therein.

PARTS LIST

1a-1c	rigid frame elements
2	movable member
4a-4d	corner elements
10	image capture side/upper rigid panel
12	non-image/lower rigid panel
14	recess
16	movable member
18	access member
20	drive piston
22	spring loaded hook/pawl
24	catch pin
26	compression spring
28	anchor block
30	floating spring stop
32	opening component
34	surface screen transport
36	support plate
38a-38c	tabs
40	durability component
42	low friction tape
44	medium spacer-guide
46	sliding idle piston
48	roller pistons
50	screen assist member
52	pair of pins
54,56	guide stiffeners
58	travel compression spring
60	pocket
62	low x-ray absorption material
100	cassette